SALEM POND

Introduction

Salem Pond is one of many natural ponds in the south end of Utah Valley. These are small, spring-fed bodies of water at the base of the mountains. Salem Pond is noteworthy because the town of Salem was built around the pond, making it one of the few natural lakes in the state that has been surrounded by a residential area. City parks surround the pond, and pedestrian bridges cross it.

The pond was created by construction of an earth-fill dam in 1851. Inflow is from clear flowing springs. The shoreline is 80% owned by Salem City and 20% by individual homeowners. Public accessibility is unrestricted. The water is used for irrigating 900 acres of land lower in the valley. No changes in water use are planned.

After 135 years of sediment accumulation, the once clear pond had become murky and chocked with aquatic vegetation and algae. The average depth of the lake had been reduced to only 7 feet. A joint project with Salem City, Mountainlands Association of Governments, the Utah Division of Water Quality, and the federal EPA was instituted to revitalize the pond. Between 1988 and 1993,

Characteristics and Morphometry

Lake elevation (meters / feet)	1,399 / 4,590
Surface area (hectares / acres)	4.45 / 11
Watershed area (hectares / acres)	192 / 474
Volume (m^3 / acre-feet)	
capacity	195,000 / 158
conservation pool	0
Annual inflow (m^3 / acre-feet)	
Retention time (years)	
Drawdown (m^3 / acre-feet)	
Depth (meters / feet)	
maximum	7 / 23
mean	4.4 / 14.4
Length (meters / feet)	579 / 1,900
Width (meters / feet)	209 / 686
Shoreline (meters / feet)	1,462 / 4,800

Location

County	Utah
Longitude / Latitude	111 40 26 / 40 03 06
USGS Map	Spanish Fork, 1979
DeLorme's Utah Atlas & Gazetteer™	Page 45, A-6
Cataloging Unit	Utah Lake (16020202)

it was drained, the fish were killed, a new drain was built

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Limnological Data

Data sampled and averaged from STORET site: 591761, 591762, 591770.

Surface Data	1981*	1989	1990	1992
Trophic Status	E	M	M	E
Chlorophyll TSI	-	36.84	43.48	45.50
Secchi Depth TSI	59.26	44.98	46.95	52.77
Phosphorous TSI	50.35	46.63	56.47	51.72
Average TSI	54.8	42.82	48.96	50.00
Chlorophyll a (ug/L)	-	1.8	4.3	9.1
Transparency (m)	0.8	2.6	2.3	2.0
Total Phosphorous (ug/L)	30	21	49	26
pH	9.5	7.8	7.9	8.1
Total Susp. Solids (mg/L)	9	-	4.9	<3
Total Volatile Solids (mg/L)	-	-	-	1
Total Residual Solids (mg/L)	-	-	-	2
Temperature (°C / °f)	18/64	19/67	16/61	16/61
Conductivity (umhos.cm)	760	727	629	676
Water Column Data				
Ammonia (mg/L)	0.08	0.10	0.04	0.05
Nitrate/Nitrite (mg/L)	2.79	1.54	1.72	1.61
Hardness (mg/L)	235	-	294	254
Alkalinity (mg/L)	244	-	269	253
Silica (mg/L)	-	-	-	5.6
Total Phosphorous (ug/L)	30	25	39	28
Miscellaneous Data				
Limiting Nutrient	P	N	N	P
DO (Mg/l) at 75% depth	7.3	14	3.0	3.9
Stratification (m)	NO	NO	NO	NO
Depth at Deepest Site (m)	4	1.7	2.4	2.7

* One site only (591761)

at the bottom of the dam, 135 years of sediments were dredged, the storm sewer was diverted onto an adjacent wetland, and the duck population was brought under control. This involved expenditure of $100,000 each in federal EPA funds and the State of Utah, and $150,000 by Salem City.

Recreation

Salem Pond is easily accessible from US-6 in Salem, which is between Spanish Fork and Payson. There is a historical marker at the pond, so drive through town and stop at the sign for the historical marker. Most of the pond is south of the highway, so one can turn south into town anywhere. It is not difficult to find, as most streets in town terminate at the pond.

Most of the pond is surrounded by park areas, with playgrounds and picnic areas. Since the cleanup, children enjoy swimming in the pond, small boats can be floated in the pond and even jetskiing is popular. The park can be used for cross-country skiing in the winter and fishing is sometimes good with hopes that it will improve as conditions allow.

There is a private campground in Payson (see info box), and several USFS campgrounds in Payson Canyon. Camping at the pond is discouraged.

Watershed Description

The pond is primarily spring fed. It also receives water from a small natural watershed, which has been modified by urbanization and truncated by an irrigation canal. Surface inflows to the pond are largely from storm sewers, and are often contaminated with fertilizers, sediments, oils, and garbage.

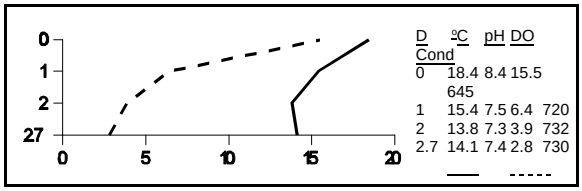
Part of the foothills drained into Salem Pond, but the construction of a canal upslope from the pond has cut off foothill runoff. The watershed high point is the canal (about 100' higher then the pond), below which water drains to the pond. Slopes surrounding the reservoir are not particularly steep (up to 20% at the south end). There are two storm sewers that feed into the reservoir, and several springs. The springs provide the majority of the water to the pond. The outlet is Beer Creek.

The watershed is made up of alluvial deposits that have been stabilized by urbanization. The soil associations that compose the watershed are listed in Appendix III.

The vegetation communities consist of disturbed sagebrush-grass, and urban vegetation. The watershed receives 30 - 41 cm (12 - 16 inches) of precipitation annually. The frost-free season around the reservoir is 120 - 140 days per year.

Land use in the watershed is 100% urban.

Limnological Assessment



The water quality of Salem Pond is considered very good. It is considered to be hard with a hardness concentration value of approximately 261 mg/L (CaCO3). The parameters that have exceeded water quality standards for defined beneficial uses include total phosphorus, and dissolved oxygen. Although the overall concentration of total phosphorus in the water column exceeds the pollution indicator the data is skewed due to higher concentration in August and September which may result as the over abundance of macrophytes die off and decomposition reintroduces nutrients into the water column. Low dissolved oxygen concentrations as indicated in the September 3, 1992 profile are due in large part to the biological activity of the plants at night through the process of respiration consume dissolved oxygen. The greatest impairment todefined beneficial uses is due to the extensive development of macrophytes in the lake. Because of this a Clean Lakes Phase I study was undertaken to study the problems contributing to the problem and develop alternatives to address the defined problems. The study was completed in 1991.

Recommendations from the Clean Lakes Phase I study included the following: dredging the lake; diversion of nutrient rich urban waters into wetlands for uptake of nutrients and sediments; reduction of an existing duck population, and the introduction of grass carp to control macrophyte densities. A complete discussion of the study is included in the report, *"Diagnostic and Feasibility Report on Salem Lake (1991)"* available from Mountainland Association of Governments or Utah Division of Water Quality.

In 1992 Clean Lakes funding was obtained from EPA to address the concerns with Salem Pond. In addition state funds and local funding from Salem City was provided to assist in the implementation of the recommendations of the Phase I study. The major components including removal of 100,000 cubic yards of nutrient rich sediments, control of an existing duck population, introduction of grass carp for control of persistent macrophytes, diversion of urban runoff into an enhanced wetland, and providing an educational tool for instruction on water quality and wetlands.

Implementation of these Clean Lakes Phase II elements indicates that water quality has improved. A review of the data presented in the report, *"Salem Lake Restoration (1995)"* available from Mountainland Association of Governments or Utah Division of Water

Quality substantiates this fact. Water was sampled during 1993, the year after implementation. The average total phosphorus concentration in the pond was 23 ug/L which is below the pollution indicator and less than previous annual concentrations. During that year the average dissolved oxygen concentration was 9.1 mg/L with the lowest recorded value of 4.2 mg/L. Although improving, it still appears that the existing macrophyte community is still exerting an influence on dissolved oxygen concentrations. It is anticipated as the grass carp develop the macrophytes will be controlled or reduced to the point that their influence will be minimal. A determination of TSI values for 1993 (40.00) indicates that the water quality has improved and production has been reduced. It should be noted that the time since implementation is relatively short and the pond should continue to be monitored to better evaluate the effectiveness of the Phase II implementation project.

Although the depth of the pond has been increased, it is still to shallow to permit stratification. In 1981 the pond was classified as a nitrogen limited system but current data suggest that it is nitrogen limited.

The Division of Wildlife Resources treated the pond prior to dredging in 1988 for the removal of rough fish and currently stocks the pond with 5,000 catchable rainbow trout (*Oncorhynchus mykiss*) annually. In addition triploid (sterile) grass carp (*Ctenopharyngodon idella*) are present in the pond.

Macrophytes document in the Phase I study include water milfoil (*Myriophyllum verticillatum*), duck weed (*Lemma gibba*), glaborous monkey-flower (*Mimulus glabrata*), water cress (*Nasturtium officinale*), and spirodela (*Spirodela polyrhiza*). The largest part of the biomass consists of water milfoil. It is associated wherever it grows with the algal genus *Chara*. The floating mat of algae is partially comprised of *Cladophora sp.*).

Phytoplankton in the euphotic zone include the following taxa (in order of dominance)

Species	Cell Volume (mm^3/liter)	% Density By Volume
Pennate diatoms	5.771	41.92
Scenesdesmus quadricauda var. quadrispina	2.179	15.83
Peridinium sp.	1.446	10.50
Cosmarium sp.	1.089	7.92
Staurastrum sp.	1.001	7.27
Unknown filamentous green alga	0.817	5.94
Mougeotia sp.	0.612	4.44
Coelastrum sp.	0.556	4.04
Tetraedron sp.	0.083	0.61
Dinobryon divergens	0.049	0.36
Scenedesmus bijuga	0.044	0.32
Oocystis sp.	0.036	0.26
Centric diatoms	0.018	0.13
Ankistrodesmus falcatus	0.017	0.13
Euglena sp.	0.017	0.12
Oscillatoria sp.	0.012	0.09
Chroococcus sp.	0.011	0.08
Chlamydomonas sp.	0.006	0.04
Unknown spherical chlorophyta	0.003	0.02
Total	13.759	
Shannon-Weaver [H']	1.85	
Species Evenness	0.63	
Species Richness	0.77	

The phytoplankton community is fairly diverse due in part to the over abundance of macrophytes present in the system. It is dominated by green algae, flagellates and desmids. It is indicative of fairly good water quality.

Pollution Assessment

Nonpoint pollution sources include the following: sedimentation, nutrient loading and household chemicals from urban areas; and litter or wastes from recreation.

There are no point sources of pollution in the watershed.

Beneficial Use Classification

The state beneficial use classifications include: boating and similar recreation (excluding swimming) (2B), cold water game fish and organisms in their food chain (3A) and agricultural uses (4).

Information

Management Agencies	
Mountainlands Association of Governments	377-2262
Division of Wildlife Resources	538-4700
Division of Water Quality	538-6146
Salem City Corporation	
Recreation	
Mountainland Travel Region (Vernal)	377-2262
Payson Chamber of Commerce	465-9288
Spanish Fork Chamber of Commerce	798-8352
L&J RV Park (Payson)	465-4761